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ABSTRACT

The purpose of this study was to investigate certification requirements for elementary teachers in educational institutions to determine their preparation in science. The amount and types of science content, the science processes and skills, science teaching techniques, and general preparation as an elementary teacher who will need to teach science were areas covered on a questionnaire distributed to 18 deans in Washington state. The results of the survey were compared to guidelines presented by the National Science Teachers Association (NSTA) for teacher preparation in 1983. The overall result was that the majority of Washington institutions do not compare favorably with the NSTA standards. Areas for future study are suggested. Appended are a copy of the guidelines adopted by the NSTA, a list of the field test institutions, institutions surveyed, copies of letters sent to institutions, and a copy of the survey. (KR)

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Washington State

Elementary Science Teacher Preparation Programs

Sandy Melchert

A Research Paper for Education 601

Submitted to
Professor Dale F. Stradling, Chairman
Dr. Wayne H. Hall
Dr. Donald J. Barnes

Eastern Washington University
Spring Quarter 1990
Running Head: Science Education

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CHAPTER I

There is growing awareness that students graduating from elementary schools are deficient in science. The quality of instruction students receive depends to a large extent on an adequate supply of well prepared teachers.

The quality of life in our society is and promises to be even more highly dependent on science and technology. Each of us makes daily decisions that are based on science and technology. The need for scientific and technological literacy is inescapable.

There is a growing realization that students' attitudes toward science are formed in the elementary grades (Lucas and Dooley 1982). These attitudes largely determine a student's capacity to learn science and understand the technology upon which our society is based. The current national focus on science education began with attention to science in the secondary schools in 1982. As states pushed for excellence in secondary school science, a common lament was heard: "If students had decent science programs in elementary school, they would at least come to us with positive attitudes towards science, and some science skills on which we could build!" (Penick 1987). The national

attention which focused first on secondary science is beginning to extend to the elementary schools (Penick 1987). Some states and school districts have responded by requiring that science be taught a certain number of minutes per day or per week (Penick 1987). Others are developing and implementing district or state-wide tests to attempt to ensure that students are attaining basic science skills during their elementary school years (Penick 1987).

Effective elementary science programs and well trained elementary science teachers are the keys to developing appropriate attitudes and skills in students (Penick 1987). But science anxiety runs rampant among this country's elementary teachers (Penick 1987). A study by Stake and Easley (1978) suggests that less than half of the nation's elementary students have a single year in which a substantial share of the curriculum is devoted to science that is competently taught. Many teachers ignore science completely.

The "back to basics" movement (from which science has been excluded) has inhibited progress in elementary science teaching at a time when our need for scientific and technological expertise is growing daily (Penick 1987).

The quality of science education in our schools greatly depends on the teachers in the classroom. The competency of the teachers depends on preservice preparation programs and state certification requirements which ensure that minimum standards have been satisfied (Blosser 1986).

In 1981, the National Science Teachers Association (NSTA) Steering Committee on Teacher Education, chaired by Mechling, set out to gather data on science teacher preparation. Stedman and Dowling (1981) studied certification practices; Donnellan (1981) investigated elementary teachers' perceptions of their preparation for teaching science; and Mechling inquired into program requirements in science for preservice elementary teachers. These collective data revealed the need to identify a desired state for preservice elementary teacher education programs and to identify practices to reach that desired state. Case studies of elementary schools revealed that science had been de-emphasized with many teachers ignoring it altogether (Stake and Easley 1978).

Cohen (1982) and Flegg (1981) collected considerable evidence that a large number of adults, including prospective elementary teachers, gave

responses similar to those of elementary school children when interviewed on fundamental science concepts. Flegg (1981) reasoned that even though many people were interested in science, it was frequently presented in school programs in a complex form and was above the level of understanding of the average person. As a result, many people became alienated from science and were unable to learn scientific concepts (Stepans and McCormack 1985). Additional studies reflected that the type of science most elementary science teachers were exposed to did not prepare them to understand or teach how science works - they were taught science as "fact rather than act" (DeVore 1984). Nearly half of the students reported science teachers rarely or never admit that they do not know "everything" there is to know about specific topics of study in the science classroom (Yager and Penick 1984).

Student opinions concerning their perceptions of the value of the study of science reported that while most believe that their study of science will be useful to them, very few feel that the things they learn in science have relevance to the real world. At the same time, the majority of students reported that they feel that what they learn in science is useful in daily

living. An even larger number feel that what they learn will be useful to them in future life (Yager and Penick 1984).

Anticipating the future needs of education students is difficult because a range of alternative scenarios is possible, depending on the choices we make now. According to Dede (1986), "The future is like a tree: one trunk (the present), many branches (alternative futures). Day to day decisions prune branches (remove alternative futures from the realm of possibility) until, after years of choices, just one future remains (the new present). Each alternative future has different implications for today's students".

Teacher attitude towards science reportedly does affect the attitude and performance of students. The most important influences on preservice elementary teachers' attitudes toward science were experiences or individuals from their elementary and junior high years (Lucas and Dooley 1982). Vannan claimed that science experiences at the elementary level had a lasting impression (Levin and Jones 1983). After reviewing the literature, Ramsey and Howe (1969) concluded that the role of the teacher in shaping pupils' attitudes and

aptitudes was paramount.

Historically, approximately 85% of elementary teachers are women. Many of these teachers lacked science preparation. They were also products of cultural influences that have operated against women with respect to science study. It is not surprising to find only 22% of all elementary teachers felt "very well qualified to teach science". As a result, less time was spent teaching science in elementary schools than any other area of the curriculum (NSTA 1982).

Inadequate science background was commonly given as a reason for teachers' reluctance to teach science and negative attitudes toward science (Blosser and Howe 1969) and teaching science were commonplace among elementary teachers. Some of the consequences of teachers' negative attitudes were the reluctance or avoidance of teaching science and the passing of negative attitudes on to students (Levin and Jones 1983).

The majority of elementary school teachers do not feel comfortable teaching science (Weiss 1978). In surveys of elementary school teachers in 12 states, four in the Southern Regional Education Board (SREB), it was found that half of the teachers responding did

not feel comfortable teaching topics in physical science (Donnellan 1982). Further evidence was found that students, especially females, perceived negative attitudes from elementary female teachers who were uneasy and anxious about teaching science. Science educators in Australia (Appleton 1977), England (Prestt 1978), and the United States (Riley 1979) have reported that primary school teachers have negative attitudes toward science. They have claimed that as a result of these negative attitudes, teachers either did not teach science at all or taught it in such a tentative and unenthusiastic fashion that the benefit of the subject to children was slight. Negative attitudes among teachers may be traced back to their own experiences at school. It seems that little has occurred in teacher education programs to counteract existing negative attitudes and replace them with positive attitudes toward science and the teaching of science (Lucas and Dooley 1982).

SIGNIFICANCE

The majority of states' certification standards allow those with elementary certificates to teach science at least through sixth grade, and many states extend certification through eighth grade. The science

requirements of teacher education programs determine the general preparation of teachers. This preparation influences the teacher when teaching science. Elementary teachers are traditionally reluctant to teach science.

STATEMENT OF THE PROBLEM

Teachers should provide an environment for children which supports curiosity, investigation, and inquiry. The lack of science teaching in the elementary schools suggests that preservice elementary teachers are not able to, or not willing to, translate practices from general methods classes into methods for teaching science.

PURPOSE OF STUDY

The purpose of this study is to investigate certification requirements for elementary teachers in educational institutions to determine their preparation in science.

CHAPTER II - A REVIEW OF RELATED RESEARCH

INTRODUCTION

Teachers are the key to the quality of children's learning in classrooms. A recent avalanche of reports from national commissions and foundations document a dismal situation in elementary science education. Many teachers in elementary schools are not qualified to teach science (Weiss 1978). The National Science Board (1983), Task Force on Education (1983), and Feistritzer (1983) reported that the "typical" elementary teacher dislikes science, fears it, and does not understand it. Since universities hold virtually all of the responsibilities for preparing future elementary teachers to teach science, it would seem important to assess:

a. requirements in elementary science for certification,

b. perceived teacher needs in preservice preparation,

c. and preservice science training in universities.

ELEMENTARY TEACHER CERTIFICATION

A survey of science teacher preparation programs was conducted by the NSTA in 1981 and published in 1982. (See Appendix for the standards adopted by the NSTA.) The sample consisted of 50 institutions

belonging to the American Association of Colleges of Teacher Education (AACTE) that produced the largest numbers of graduates in 1979-80. Examination of their program requirements showed that in most cases the NSTA recommended standards on science content were not being met. Three programs required courses in all three science areas: biological, physical, and earth. A majority of the deans from the Southern institutions felt that more science content should be required (Cornett 1983). Strengthening the general education component at universities was seen as improving the science preparation of elementary teachers (Mechling, Stedman & Donnellan 1982). The survey was utilized to develop a position statement by the NSTA concerning the preparation and certification of elementary school teachers who teach science in addition to other subjects (Mechling 1982). Although only 19 of the states reported that they had a science requirement for early childhood education, 36 required science for elementary certification. The requirements varied by region. All Southeastern states required science for elementary teachers, but only 10 of 14 Western states did (Mechling 1982).

Although the states surveyed required "science", they did not specify which science courses were most appropriate for prospective elementary school teachers. Only seven required a course in biology or physical science for preservice teachers. No state required an earth science course. Lack of specific requirements is significant when considering that 18 of the states certify elementary school teachers through grade eight - which means they may end up teaching middle school or junior high science. Only one-fourth of the states required a science methods course for elementary school certification (Mechling, Stedman & Donnellan 1982).

INADEQUATE TEACHER PREPARATION

Departments of Education hold virtually all the responsibilities for background preparation and teaching methods of elementary preservice teachers. Blosser and Howe (1969) reviewed all research studies concerned with preparation of elementary teachers to teach science that were published before 1969. Their findings are still relevant more than 20 years later. When studies of elementary teacher preparation in science were compared with studies dealing with the preparation of secondary teachers, it was found that

science educators tended to concentrate their efforts at the secondary level. Little emphasis was placed on addressing the problems in preparing elementary teachers. This situation persists despite the continual criticisms that elementary teachers do an inadequate job of teaching science and that many are reluctant to teach science. If this situation is to be changed, attention should be given to such problems as finding methods for improving the science competencies of teachers, determining optimal content background and types of experiences in science for elementary teachers, and building positive attitudes toward science. These experiences should be part of every elementary school curriculum (Blosser and Howe 1969).

Three studies conducted by the National Science Foundation (NSF) during the late 1970s reported an alarming number of problems in elementary science education in the United States. Project Synthesis (Harms and Yager 1981) summarized the studies related to science education during the 1957-75 period. The information surveyed the practices in the schools, instructional materials, teacher education, financial control and the school administration, and the needs in K-12 science programs. Weiss (1978) conducted a

national survey of teachers, administrators, supervisors and other school personnel. She collected information concerning curricula, course offerings, teaching methods, enrollments, teaching assignments, support services, and teaching practices as they related to the location of each institution. She found that science instruction was limited in elementary schools and nearly 67% of elementary teachers perceived themselves as "not well qualified" to teach science. Helgeson, Blosser, and Howe (1977) found that lecture and discussion was the most common elementary science teaching strategy. Stake and Easley (1978) conducted eleven in-depth case studies of elementary schools through on-site visits. Each school selected represented a different type of community. They also found that science was not emphasized and frequently was ignored. Weiss' (1978) surveys of state science supervisors and elementary school principals found that they concurred that elementary teachers were inadequately prepared to teach science. Additional studies have shown inadequacy as perceived by preservice teachers as a handicap to their teaching of science (Zeitler 1984). It seems apparent then, that preparation programs in science for preservice

elementary teachers need to be improved.

Uniform guidelines and standards for the preparation and certification of science teachers do exist. The earliest set were prepared by the Commission on Science Education of the American Association for the Advancement of Science (1970). However, they had not been reviewed or changed in more than a decade. During this time period, three NSF studies neglected the area of preservice training, yet it was recognized that good preservice programs are the best assurance of qualified teachers (NSF 1980). The authors of the NSF analysis concluded it is more difficult to correct deficiencies in academic backgrounds once teachers have been certified than to require adequate preparation before certification.

ELEMENTARY TEACHERS DESCRIBE THEIR PREPARATION

In January of 1982, the NSTA Preschool/Elementary Committee conducted a survey of elementary teachers to gain some descriptive and evaluative data about their preservice preparation in science education. The survey was designed as a two part questionnaire, which was circulated to 150 teachers in 12 states including Washington. In six states, the questionnaire was mailed directly to elementary teachers whose names had

been randomly selected from a computer list. In the other states, committee members circulated the questionnaire to local teachers, excluding those who were NSTA members and those who showed a special interest in science. Ninety-nine completed questionnaires were included in the final tabulations, representing at least five teachers in each state surveyed. The computer listing accounted for one-third of the responses, and teachers selected by committee members made up the rest. Although the survey was small, it represented practicing teachers in twelve states, with a good distribution of grade-level assignments and number of years of experience (NSTA 1982).

The NSTA (1982) questionnaire revealed the following areas of concern.

a. 55 out of 99 teachers felt their undergraduate work inadequately prepared them to teach science.
b. Teachers with up to 15 semester hours of science content courses felt inadequately prepared to teach science.
c. Half of the teachers felt inadequately prepared to teach science as a hands-on activity.
d. Cross tabulation of two items indicated that half of those teachers who had a separate elementary science methods course felt inadequately prepared to teach science.
e. More than half of the teachers responding felt uncomfortable teaching topics in physical science.
f. 65 of the teachers had not completed any graduate courses in science education.
g. Graduate assistants or teaching assistants were frequently used as class instructors in preservice

elementary education majors.
h. 70 of the teachers did not have access to inservice training in elementary science.
i. 63 of the teachers did not have science consultant services available, that number counted publishing company representatives as consultants.

SURVEYS OF PRESERVICE PREPARATION

Mechling, Stedman, and Donnellan (1982) surveyed the 50 institutions of higher education that had the largest number of teacher education graduates during the 1979-80 school year. Colleges were selected based on information received from the AACTE. The survey was used to develop a position statement by the NSTA concerning the preparation and certification of elementary school teachers who teach science in addition to other subjects. The study had three phases.

a. Gather data on teacher education and certification.
b. Use the data as a basis for proposing NSTA standards for science teacher preparation.
c. Share the standards with colleges and universities, accrediting agencies, state certification officers, and others concerned with science teacher preparation and certification.

The results of the study were used as the basis for forming the recommended standards for preparing teachers of science at the elementary level (NSTA 1982). This was the first major review of elementary science teacher preparation since the AAAS Commission of Science Education report of 1970.

In Mechling's 1982 study, all of the responding colleges and universities except one (44 out of 45) required elementary teacher candidates to complete science courses, but only eight institutions required courses in each of the following areas of science: biological, physical, and earth science. This means that for the other 37 institutions, preservice elementary teachers needed to take courses in only one or two of subject areas they would be expected to teach (Mechling 1982). Half of these leading teacher education institutions required only eight semester hours or less of science for students preparing to teach science at the elementary level- practically the same number of hours required for ALL students, whether expected to teach science or not (Mechling 1982). Seventeen of the institutions designed science courses specifically to meet the needs of elementary teacher candidates. Thirty-three required science courses that included laboratory experiences and activities designed to teach science process skills (Mechling, Stedman & Donnellan 1982).

Forty-two of the institutions surveyed required a science teaching methods course. Thirty-seven required a single methods course, two required both a science

methods course and a general methods course, two required only a general methods course. Teacher preparation programs emphasized science process, methods, and teaching techniques rather than science content. The deans surveyed indicated a need for increased requirements in all science areas: content, process skills, and teaching techniques. Approximately half of them felt that more hours should be required in all three categories (Mechling 1982).

Science content was considered the area of greatest need. Two-thirds of the deans ranked their science teaching preparation programs as either excellent or good. The deans were asked to offer specific suggestions for improving preservice science teaching programs. The three responses given most often were to: a. provide more science content courses, b. provide more science methods courses, and c. require more laboratory science courses specially designed for elementary teachers (Mechling 1982).

The Horn and James study (1981) was designed to parallel three national studies and to reveal state results on the state of Kansas. This questionnaire also dealt with teacher background, teacher preparation and practices, and perceived teacher needs. The

results of the survey were to show areas of need and support which would help local school districts and colleges/universities develop programs to enhance science teaching in the elementary schools. By first assessing and analyzing factors that influence elementary science teachers, effective training programs could be developed which would capitalize on areas teachers perceived to be the most relevant. The rationale for the study was based mainly on the need for baseline data which professionals in Kansas could use to expand and update elementary science instruction.

A questionnaire which reflected both local and national concerns in science education was developed. This questionnaire was mailed to a random sample of teachers drawn from the records of the Kansas Department of Education. Only 22 teachers responded during the time of the study, however the authors felt justified in reporting the results since the findings signified trends which additional data may have more fully revealed. In addition, their results were consistent with the findings in the larger national studies. Most of the elementary teachers were female and did not hold a degree beyond the BA level. Their

undergraduate area of concentration was in some subject other than science or mathematics. They did not feel prepared or qualified to help other teachers in any of the areas of elementary science instruction. Only two of the respondents had any participation in an NSF sponsored institute, conference, or workshop.

Science teaching practices of the respondents varied greatly. Class discussion was the most frequently used technique. Hands-on manipulatives or laboratory materials were not generally used daily, but were most often used at least once a week. When comparing the time of instruction devoted weekly to teaching science, mathematics, social studies, and reading, science instructional time ranked last. Also Horn and James (1981) indicated most teachers had portable science kits or materials to use in their classroom. Fifteen percent reported they had no facilities or materials available to them.

Time demands on teachers, attitudes toward science, and inadequate teacher preparation were factors affecting science instruction. Teachers needed help using and maintaining manipulatives and equipment. They felt storage space, work space, and money to buy supplies were hindering them from providing good

science instruction.

The fourteen states that comprise the Southern Regional Education Board (SREB) region were evaluated concerning the status of certification requirements and the content programs to prepare elementary science teachers. In the SREB region, the grades covered by elementary certificates varied considerably, according to the NSTA survey. The majority of the states' certification standards allowed those with elementary certificates to teach at least through the sixth grade, with seven states extending certification through the eighth grade. All 14 states had science requirements for elementary teachers. With the exception of five states, those requirements were weak in terms of science content. Only half of the states required at least one course in biological science and one course in physical science. Only Tennessee specifically required the elementary teacher to have an earth science course. Four states required a separate course in elementary science methods (Cornett 1983).

Barrow (1987) gathered data about the amount and types of science content, science processes and methods, science teaching techniques, effectiveness of science preparation, and general preparation of

elementary science teachers in New England teacher education institutions and their programs and how they compared to the Mechling (1982) study.

A 28 item survey was mailed to 97 teacher education institutions of New England. The surveys were completed by the Deans/Department Chairs at each institution. There was an 83% return rate. Data was analyzed utilizing the Statistical Package for the Social Sciences. The FREQUENCIES subprogram provided the results.

Almost 85% of the institutions required elementary education majors to take at least one science class. Almost 74% required preservice teachers to take an elementary science methods course. Thirty-five percent of the institutions had science content courses specifically designed for elementary education majors. Almost 50% of the institutions allowed their elementary education majors to determine which science courses they took. The responding administrators rated their preservice science preparation programs: 14% excellent, 33% good, 35% adequate, and 15% poor. Administrators listed changes they perceived as needing the highest priority to improve their science preparation program. The first priority was to provide students with more

science content; second, to offer a problem solving oriented science course specifically designed for elementary education majors; and third, to offer an elementary science methods course.

SUMMARY

Educational institutions with teacher preparation programs must identify and propagate practices that relieve science anxiety and provide teachers with attitudes, skills, and knowledge to teach science effectively. It is easier to prepare teachers properly than it is to provide remediation once they have been certified and are teaching. The science courses teachers commonly take are surveys designed for non-majors. Their only alternative is to enroll in courses designed as a first step in a series of courses for people who intend to work in traditional science professions.

CHAPTER III

PROBLEM STATEMENT

The purpose of this study was to describe the status of certification requirements for elementary teachers in educational institutions in Washington State to determine their preparation in science. The survey instrument was a questionnaire based on the Mechling (1982) and Barrow (1987) instruments. The study collected data about the following areas of preparation in science:

a. the amount and types of science content
b. science processes and skills
c. science teaching techniques, and
d. general preparation as an elementary teacher who will need to teach science.

This study provides an opportunity to compare science requirements of teacher education programs in Washington State with the results of the Mechling study used to develop the NSTA guidelines in 1983.

METHODS

This study was designed to collect data from the 17 public and private, church and nonchurch affiliated, universities and colleges in Washington. In order for an accurate baseline to be made, each institution was

surveyed. Names of institutions with teacher education programs were received from Dr. Lillian Cady, Professional Education and Certification Office, Superintendent of Public Instruction (SPI) Office, in Olympia.

INSTRUMENT DEVELOPMENT

A mail survey was considered the least costly approach which could quickly and easily reach the widely scattered institutions. This approach offered the respondents the advantage of answering the questions in private and at their leisure. Thus, the respondents would be more likely to give honest answers (Berty 1979).

An initial review of research literature was conducted to locate previous studies in this area and to identify important variables and approaches that have been tried and found successful. A preliminary set of questions was developed taking into consideration the sources of major errors - sampling design, instrument design, and respondent reaction. The instrument was submitted to several instructors and revised based on the feedback. Questionnaire items which could be used to answer the research questions were written, or if they appeared in earlier studies

were revised, and a preliminary draft of the questionnaire was prepared. The instrument was also designed based on information from, "Ye olde maile survey" (Berty 1979).

A simple master time schedule was designed to consider the pacing of the survey. Approximate dates and estimated hours needed to complete each step were determined in advance. The survey was timed to be mailed not to conflict with holidays or the starts or endings of the quarters/semesters of the institutions involved. A Murphy's Law allowance of three extra weeks was built into the time schedule for flexibility in case disaster did strike. Instrument development, including item construction, review, field testing, and revision began in September, 1989, and continued until mid-January, 1990. The preliminary drafts were reviewed by Dr. Judy Leach and Dr. Jack Fletcher, Education Department at Eastern Washington University, Dr. Bob Gibbs, Physics Department at Eastern Washington University, Prof. Dale Stradling, Department of Anthropology and Geography at Eastern Washington University, Dr. Ken Mechling, Clarion University, Clarion, Pennsylvania, and Dr. Lloyd Barrow, University of Missouri in Columbia, Missouri. This researcher

specifically studied other questionnaires and sought the collaboration of experts on these questions to guard against omission of what might be a vital item, but also to isolate and identify specific items for respondents to consider that would tend to objectify and standardize responses. Based on the feedback, items were omitted, rewritten, or added to fill existing gaps in the questionnaire.

A field test of the 25 item questionnaire was conducted by mailing the instrument to the five four-year Idaho institutions that prepared elementary teachers. Idaho institutions were selected for the field test to prevent predisposition toward any item on the survey by the Washington institutions. Each reviewer was asked to complete the questionnaire and to comment on the importance of the information being collected, adequacy in the item format, and unclear or ambiguous questions. Instructions for return of the instrument were placed on the instrument. Basic terms were used, so definitions were not included. Every effort was made to formulate neutral wording, so as not to bias the respondent to give one kind of answer rather than another. Once the format was established, it was not varied, to prevent confusion. Sentence

structure for each item was short and simple. The first part of the questionnaire was designed not to anger or offend the respondent. Every item on the instrument required a response. The final questionnaire was revised based on feedback from the five Idaho institutions, Dr. Barrow, and Dr. Mechling.

The physical layout of the instrument was designed to be easy to read and follow. A title was selected that described the instrument. Generally, a closed form instrument was designed. This allowed for clear and objective questions. The closed form instrument provided ease to administer and fill out, kept the respondent's mind on the topic, and was easy to process and analyze. A multiple choice item format was generally used. It provided a range of possible answers, which allowed anticipation and categorization of item responses. There was also a respondent safety valve as an option, "other". On some opinion questions, the response format was similar to a Likert-type scale. There were also some multiple response questions, which were designed as a checklist. These field test results further refined the instrument. The final version of the instrument was approved in late January of 1990. (See Appendix)

DATA COLLECTION

Once the instrument and data collection procedures had been approved, a cover letter was designed. (See Appendix) The letter included a brief statement of purpose, an appeal to professional responsibility to establish this baseline, and a firm and reasonable return date. The instrument was mailed to the 18 Deans of the universities and colleges in Washington State that certified elementary education teachers on a Tuesday, in order to reach them by Thursday. It was hoped that the respondents would be more likely to complete the questionnaire at the end of the week as they cleared off their desks. This research was designed to be a baseline study, so the total population studied in this survey included every institution in the state that certified elementary education teachers.

On January 22, 1990, personalized letters and the questionnaire were mailed. Each Dean was asked to complete the questionnaire. A postage-paid envelope was enclosed and home and work phone numbers were provided if the Dean had any questions about the survey. A deadline date of February 15, 1990, was requested. The initial response rate was 58%.

Three weeks after the initial mail out, on February 15, 1990, a follow-up letter was sent out to all deans requesting that they return the questionnaire. A second copy of the questionnaire was enclosed, with a self-addressed stamped envelope. By the requested return date of February 28, 1990, eighty-four percent of the forms had been received.

Non-respondents were contacted by telephone, and additional materials were sent to schools again. These procedures increased the response rate to 100% by March 15, 1990.

ANALYSIS

Completed questionnaires were visually checked as they were returned from each institution. Each survey was coded according to type of institution. Manual editing was used to identify and resolve multiple responses. Often questionable responses were checked by phone. Non-numeric open-ended responses were also reviewed at this time and responses were tallied. Because the population was small, manual tabulation was used to process the data.

Data were compiled and percentages tabulated for each question according to the type of institution as well as a composite state total.

CHAPTER IV

In the following summation, each question has been stated and the results tabulated and discussed. There are 17 institutions in Washington that prepare elementary teachers. Data are given as percentages by type of institution and as a state composite total. All data will be presented to the nearest whole percent. Each institution represents about 6% of the state total. This researcher found that the state composites were often not a true reflection of the general trends in the institutions, especially when the data were considered in terms of the number of students certificated by each of the institutional types. Data are illustrated by exploded pie graphics. Each wedge represents how the public institutions (pink), private church affiliated institutions (green), and private nonchurch institutions (yellow) weight an item.

Antioch was also mailed a survey, although they will not be eligible to certify teachers until 1991. Of the institutions that responded, 16 of the 18 requested a summary of the findings from this research. Field test institutions, Dr. Barrow and Dr. Mechling also requested research results.

PRESERVICE ELEMENTARY SCIENCE EDUCATION QUESTIONNAIRE

Part I: Introductory

1. Does your institution prepare preservice elementary teachers?

All institutions surveyed responded affirmatively, except Antioch University. Antioch reported they are currently preparing a program, and hope to begin certification in January of 1991.

Part II: Elementary Teacher Preparation

1. In which of the following categories are elementary education graduates from your institution certified to teach?

6% K-6, statewide composite

94% K-8, statewide composite

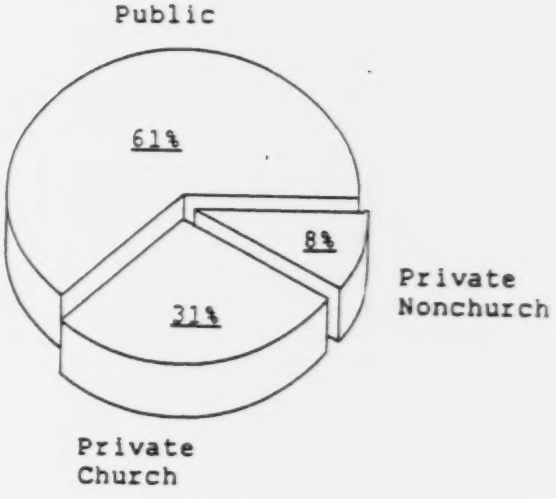
Nearly all the institutions certified elementary teachers K-8. Whitman College in Walla Walla certified teachers K-6. Walla Walla College and Central Washington University each offered additional certifications, K-12 and P-3, respectively.

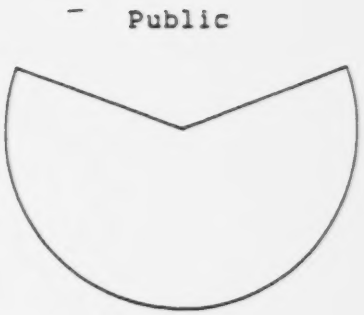
2. What is the number of elementary education majors that graduated from your institution in 1989?

A total of 1438 elementary teachers graduated from institutions last year. Public institutions had 889 graduates (61% of the state total), private church institutions had 451 graduates (31% of the total), and private, nonchurch affiliated institutions had 108 graduates (8% of the total).

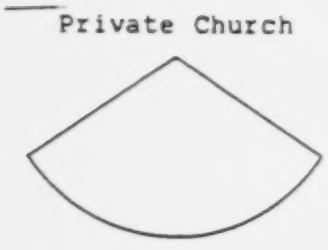
2. What is the number of elementary education majors that graduated from your institution?

1438 total graduates statewide

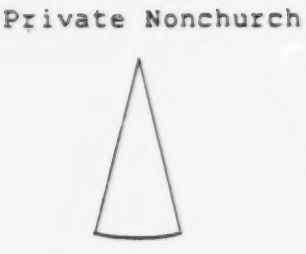




889 graduates



451 graduates



108 graduates

INSTITUTIONS SURVEYED

	Number of 1989 Graduates	State Percentage
PUBLIC INSTITUTIONS	889	61.4%
Central Washington University	293	20.1
Eastern Washington University	200	13.9
Evergreen State College	37	2.6
University of Washington	120	8.3
Washington State University	114	7.9
Western Washington University	125	8.6
PRIVATE, CHURCH AFFILIATED INSTITUTIONS	451	31.1%
Gonzaga University	80	5.5
Pacific Lutheran University	73	5.0
Saint Martin's College	44	3.0
Seattle Pacific University	84	5.9
Seattle University	60	4.1
Walla Walla College	20	1.4
Whitworth College	90	6.2
PRIVATE, NONCHURCH INSTITUTIONS	108	7.5%
City University	27	1.9
Heritage College	24	1.7
University of Puget Sound	52	3.6
Whitman College	5	0.3

3. What is your full-time enrollment during the 1989-90 academic year in the School of Education?

The current enrollment for all institutions is 6985 students. Public institutions currently have 5027 students (72% of the total), private church institutions have 1440 enrolled (21%), and private nonchurch institutions have an enrollment of 518 (7% of the total).

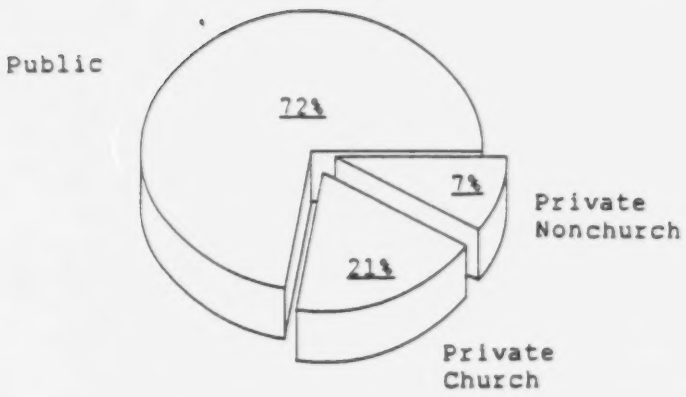
This researcher noted that when comparing the percent of graduates to the percent of total enrolled, private nonchurch institutions remain relatively the same, enrollment vs. graduates of private church institutions increased by 10%, and public institutions decreased by 10%. After being contacted by phone, the registrar offices reported that 10% of the public institution students transferred to private church institutions during the course of their studies. It would be interesting to explore this trend to discover if it was circumstantial or substantiated.

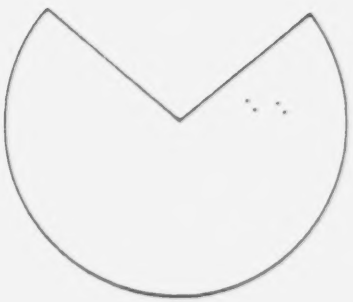
4. Which of the following describes your college or university?

There are six public institutions in the state, seven private institutions with church affiliation, and four private institutions that are not church affiliated which prepare teachers in Washington.

3. What is your fulltime enrollment during the 1989-90 academic year in the School of Education?

6985 total enrollment statewide





Public

5027 enrollment

Private Church

1440 enrollment

Private Nonchurch

518 enrollment

5. For elementary teacher candidates, how many total credit hours of science are <u>required</u> (excluding science methods courses)?

In order to compare semester hours to quarter hours, semester hours were computed at the rate two semester hours equal three quarter hours. Public institutions varied in their science requirements from eight quarter hours to twenty quarter hours. The average required science was 13.66 quarter hours. Private, church affiliated institutions varied from five quarter hours to twelve quarter hours, with the average being 6.71 quarter hours. Private institutions without church affiliation ranged from no individual science course required to eighteen quarter hours. The average for this last group was 8.75 quarter hours. It should be noted that Heritage College requires 12 semester hours (18 quarter hours) of science. If Heritage College is removed from the private, nonchurch affiliated institutions, the average of the remaining institutions is 5 quarter hours. The state average when combining all the institutions was 9.64 quarter hours.

The range was from 3 quarter hours to 20 quarter hours. Results were bi-modal at 5 quarter hours and 12 quarter hours, the median was 8 and the mean was 9.64.

According to state guidelines, all elementary teachers are required to have a science course before certification is granted. After contacting the institution by phone that responded stating no individual science course was taught, I questioned how they passed the state certification guidelines. The response was that they combined their science with either a health or math methods class, and in most cases reduced the hour requirement from an individual class total varying from 6-8 credits, to a total of 4-5 credits for the new combined methods class. Since there is no minimum credit listed for the science requirement, the institution does comply with the letter of the law for certification requirements. (Whitman College)

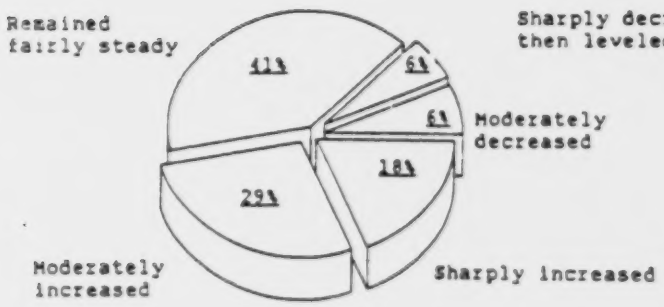
The NSTA guidelines suggest that elementary teachers have a minimum of 12 semester (18 quarter) of science preparation and laboratory experience. The NSTA guidelines suggest an additional separate science methods course be required and that it is not reflected in the 12 semester hours of basic course work.

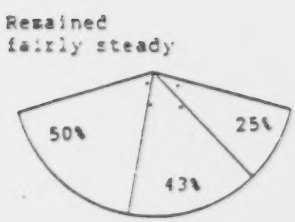
6. During the past five years, which of the following best describes the yearly trend of undergraduate elementary education majors that have graduated from your institution?

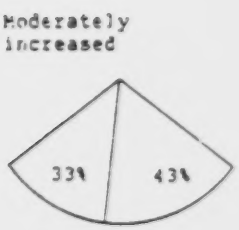
	Public	Private Church	Private Nonchurch	Total
Sharply decreased	0	0	0	0
Sharply decreased, then leveled off	0	0	25%	6%
Moderately decreased	17%	0	0	6%
Remained fairly steady	50%	43%	25%	41%
Moderately increased	33%	43%	0	29%
Sharply increased, then leveled off	0	0	0	0
Sharply increased	0	14%	50%	18%

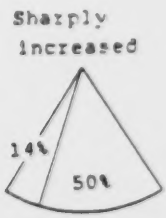
The composite total above does not reflect the trends of the three major types of institutions in the state. Public universities, which account for 61% of all teachers, have generally remained fairly steady at three institutions, with two institutions reporting a moderate increase, and only one reporting a moderate decrease. Private church institutions, which account for 31% of the new teachers, reported three remained steady and three had a moderate increase. One institution reported a sharply increased number of elementary education graduates. The remaining seven percent of teachers are prepared by private, nonchurch affiliated institutions. One institution reported a sharp decrease, and then a leveling off, one institution reported they remained fairly steady, and two reported a sharp increase in graduates.

6. During the past five years, which of the following best describes the yearly trend of undergraduate elementary education majors that have graduated from your institution?









7. Which of the following changes has the science component of your elementary education program undergone during the past five years? (Check all that apply)

	Public	Private Church	Private Nonchurch	Total
Fewer course offerings	0	0	0	0
Increased course offerings	29%	12%	25%	21%
Smaller class or section size	0	12%	25%	11%
Larger class or section size	0	12%	0	5%
Decreased number of credits per course	0	0	25%	5%
Increased number of credits per course	0	26%	0	11%
Decreased science education budgets relative to other components of teacher education	0	0	0	0
Increased science education budgets relative to other components of teacher education	29%	12%	0	15%
No change	42%	26%	25%	32%

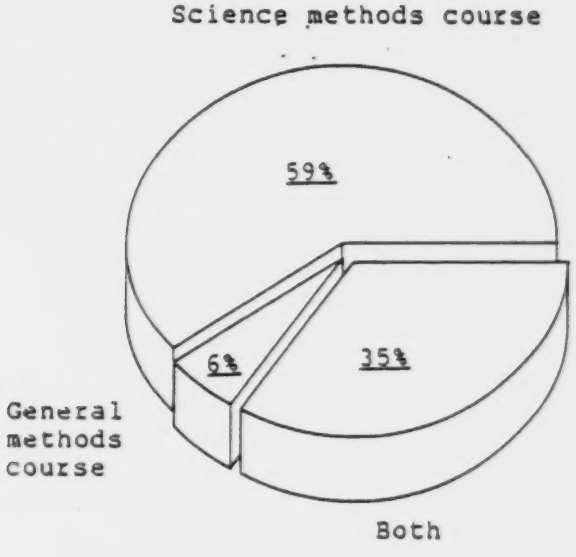
This was a checklist format item, therefore institutions could respond with more than one answer. Two institutions, Evergreen and City University, did not respond to this item. Several institutions mentioned they were preparing a Master in Teaching (MIT) program, which would have an integrated science methods course. At other institutions, the science methods class had been combined with the math methods course or a science/health methods course existed.

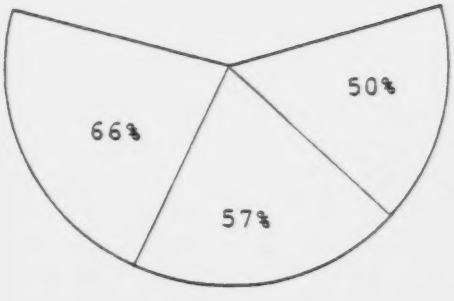
8. Do your preservice elementary teachers take a science teaching methods course designed to assist them to learn how to teach science or is science included in a general methods of instruction course?

	Public	Private Church	Private Nonchurch	Total
Science methods course	66%	57%	50%	59%
General methods course	17%	0	0	6%
Both	17%	43%	50%	35%

Over half of all the institutions have a separate science methods course designed for preservice elementary teachers. In addition, nearly one-third of the institutions have both a general methods and a science methods course to prepare elementary teachers. Statewide, Washington ranks 94%. In Mechling's study, 94% of the institutions either had a specific course or had both a science and a general course.

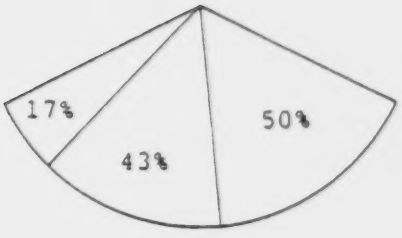
8. Do your preservice elementary teachers take a science teaching methods course designed to assist them to learn how to teach science or is science included in a general methods of instruction course?





Science methods course

General methods course



Both

9. Are elementary teacher candidates required to elect additional science courses beyond general university requirement's?

	Public	Private Church	Private Nonchurch	Total
Yes	17%	0	25	12%
No	83%	100%	75%	88%

Is a science methods course an option?

Every institution reported that a science methods course was NOT an option. Generally, institutions do not require additional science courses.

10. Are elementary teacher candidates required to take science courses as a part of their general university requirements, their professional education requirements, or both?

	Public	Private Church	Private Nonchurch	Total
General university requirement	33%	57%	50%	47%
Professional education	17%	0	25%	12%
Both	50%	43%	0	35%
No response	0	0	25%	6%

Mechling reported 5% of the institutions required science courses for their professional education preparation, 54% required course work for both professional and general requirements, resulting in a composite of 59% requiring additional science. Although in Washington the statewide total is nearly 12% for professional education requirements, the overall rate is 47%, twelve percent below Mechling's results.

11. In which of the following areas are elementary teacher candidates required to take courses? (Check all that apply)

	Public	Private Church	Private Nonchurch	Total
Physical sciences	27%	33%	0	25%
Biological sciences	27%	67%	0	31%
Earth sciences	19%	0	0	13%
General science	27%	0	100%	31%
Physical Geography	0	0	0	0

One public university required 20 quarter hours from the natural sciences to meet their general university requirements, but students had their choice of the classes selected. Another public university required 8 quarter hours in natural science. Private nonchurch institutions also had varying requirements. One institution required 12 semester hours of science electives from all 5 areas. Whitman College has distribution requirements which specify areas of study, including science, however, no specific requirements are given. At the University of Puget Sound, students must take two courses from the physical, biological, or earth science, plus two additional lab courses - however, no area is specified. Private church institutions had the least required science - one institution required a Natural Science course with lab, another required any lab science, a third, one course in any of the above, a fourth, a two quarter sequence of Biology, Chemistry, Physics, or Astronomy, and the last institution wrote that students could elect from any of the above to be used towards their general university requirements, for a total of 8 quarter hours.

According to Mechling, physical science was required 22%, biological science 23%, earth science 12%, any of the above may be elected 25%, required all three content areas 9%, and 9% were reported as "other". Washington institutions matched only with the earth science requirement. More biology is required statewide, with general science required nearly one-third of the time.

12. How many hours of science are required in each area for elementary teacher candidates?

Since few institutions had defined science requirements according to subject matter, each area is listed, and following it are the number and type of university that require that science area in their preparation program. Following this listing is a topic entitled "Other", in which all other responses to this question are tabulated and discussed.

Physical science
2 public - Central 5, Western 4
3 private church - Pacific Lutheran University 4, Heritage 3-4, Puget Sound 4

Biological science
2 public - Central 5, Western 4
4 private church - Gonzaga 4, Pacific Lutheran University 4, Puget Sound 4, and Heritage 3-4

Earth Science
1 public - Western 4
2 private church - Heritage 3-4, Puget Sound 4

General Science
1 public - Western 4
1 private nonchurch - City University 5
1 private church - Heritage 3-4

Physical Geography
1 private church - Heritage 3-4

Public Institutions - University of Washington requires 20 quarter hours in natural sciences from the general university requirements, Evergreen requires 8 quarter hours of natural science, Eastern Washington requires 12 quarter hours of science selected from any 3 general university required courses mandating that one include a lab, and Washington State requires 6 semester hours total from physical, biological, earth, and/or general science.

Private Church Institutions - Whitworth requires none beyond general university requirement of <u>one</u> course from any of the categories, Saint Martin's requires 4 semester hours of natural science with lab, Walla Walla

requires 8 quarter hours in two four-hour sequences of Physics, Biology, Earth Science, or General Science, Seattle University requires 5 quarter credits in any area, Seattle Pacific requires at least one 5 quarter hour course in any of the 5 areas.

Private Nonchurch Institutions - Whitman has distribution requirements which specify areas of study, including science, however no specific requirements are given.

13. How many of the science content courses required of elementary education majors must include laboratory work? (Check one)

	Public	Private Church	Private Nonchurch	Total
No Lab	0	14%	50%	18%
One Lab	83%	57%	0	53%
Two Labs	17%	29%	50%	29%

City University and Whitworth required no lab experience. Whitman College did not respond, and was tallied as not having a lab. No institution required more than two science courses with laboratory work.

Mechling reported nearly three-fourths (73%) of the respondents offered courses which included laboratory experiences and activities. Washington has an 82% composite.

14. If science courses are required, are they designed specifically to meet the needs of preservice elementary teachers?

	Public	Private Church	Private Nonchurch	Total
Yes	34%	14%	50%	29%
No	66%	86%	50%	71%

One private church institution commented that a science course specifically designed for elementary teachers was not required, but that they did have electives available that were specifically designed to meet this need.

According to Mechling, 37% of the institutions did have specific classes.

15. Are preservice elementary teachers taught science process skills such as observation, measurement, prediction, analysis of data, control of variables, and design of investigations, etc?

	Public	Private Church	Private Nonchurch	Total
Yes	100%	100%	75%	94%
No	0	0	25%	6%

City University was the only negative response.

Washington preparation programs compared favorably to Mechling's report on this item. Of the 50 institutions in Mechling's study, 76% responded positively.

16. Where are these process skills taught?

	Public	Private Church	Private Nonchurch	Total
Science courses	0	14%	0	6%
Methods courses	67%	29%	75%	53%
Both	33%	57%	25%	41%

Public and private nonchurch institutions reported that process skills are not taught in their science courses, while private church affiliated institutions taught process skills in both science and methods courses.

This researcher feels that perhaps process skills are taught in some science content courses and that education faculty may not be aware of this fact.

17. Do the science method courses taken by the elementary teacher candidates include laboratory experiences and hands-on activities in addition to lecture?

	Public	Private Church	Private Nonchurch	Total
Yes	66%	100%	75%	82%
No	17%	0	25%	12%
No Response	17%	0	0	6%

City University did not respond to this item. The majority of institutions responded favorably. Two institutions statewide do not include hands-on activities.

18. *In your estimation, what factors have had the most influence in determining the science and/or science teaching methods course requirements for elementary teacher candidates at your institution?* (Check all that apply)

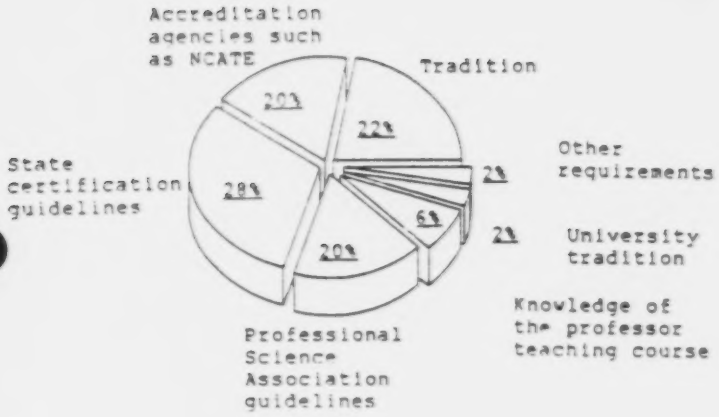
	Public	Private Church	Private Nonchurch	Total
Tradition	23%	29%	0%	22%
Accreditation agencies such as NCATE	15%	21%	22%	20%
State certification guidelines	31%	25%	34%	28%
Professional Science Association guidelines	15%	21%	22%	20%
Knowledge of the professor teaching course	8%	0	22%	6%
University tradition	8%	0	0	2%
Other requirements	0	4%	0	2%

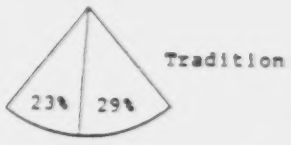
Although state certification guidelines received the greatest number of responses, it appears that all of these factors are important to consider. State certification received the largest percentage (28%) of responses in Mechling's study. Tradition followed with 23%, Professional Science Association Guidelines received 17%, and NCATE received 14%. Mechling reported most of the responses in the "other" category (18%) referred to the strength, interest, and competence of the faculty as being most influential.

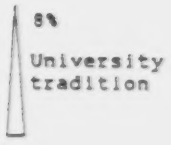
Washington's results are nearly identical when comparing state guidelines, tradition is a little lower, and professional science guidelines are

generally higher (particularly in private, nonchurch institutions). NCATE has more influence with all types of institutions in Washington.

10. In your estimation, what factors have had the most influence in determining the science and/or science teaching methods course requirements for elementary teacher candidates at your institution?





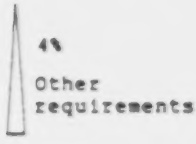


Professional Science Association guidelines

State certification guidelines

Accreditation agencies such as NCATE

Knowledge of the professor teaching course



19. As you consider your total program for preparing preservice elementary teachers for teaching science, how would you rate its overall effectiveness?

	Public	Private Church	Private Nonchurch	Total
Excellent	0	0	0	0
Good	50%	42%	50%	47%
Adequate	50%	29%	50%	41%
Poor	0	29%	0	12%
Don't know	0	0	0	0

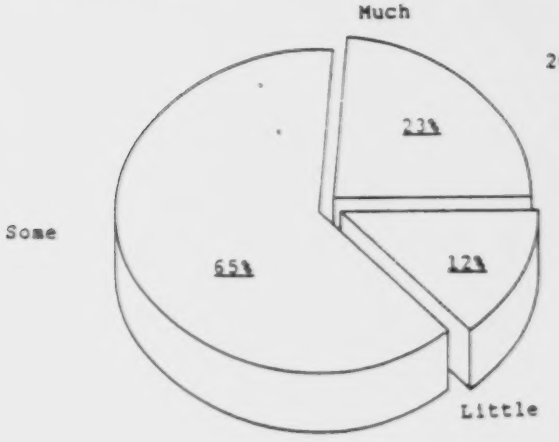
One public institutions marked adequate, yet they required 16-20 quarter hours of science - one of the highest number of hours required by all the institutions. One private church institution ranked their methods adequate and their content poor. A private nonchurch institution marked good, and added the postscript, "and getting better"!

Two-thirds of the respondents in Mechling's study ranked their preparation programs as excellent or good (11% excellent, 55% good). Forty-seven percent of the institutions ranked themselves good in this study, none ranked themselves as excellent. Mechling reported 34% ranked themselves as adequate or poor. Washington institutions ranked 53% of their programs as adequate or poor.

20. In your program, how much emphasis is currently placed on the following science education areas?

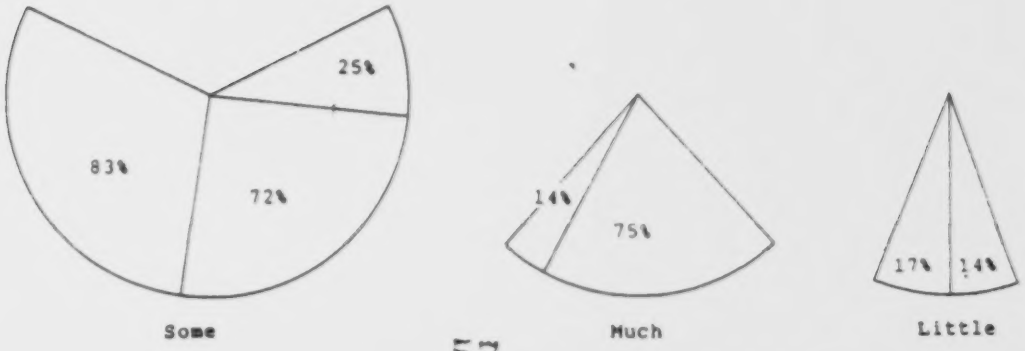
	Public	Private Church	Private Nonchurch	Total
Science Content:				
Much	0	14%	75%	23%
Some	83%	72%	25%	65%
Little	17%	14%	0%	12%
Don't Know	0	0	0	0

Mechling reported 31% much, 49% some, and 20% little. Almost 70% of the respondents indicated that content received some or little emphasis in Mechling's study. In Washington 77% of the institutions indicated that content received some or little emphasis. All public institutions responded in this range. Private nonchurch institutions were the only ones to rank the majority of their programs as receiving much content.



20. In your program, how much emphasis is currently placed on the following science education area?

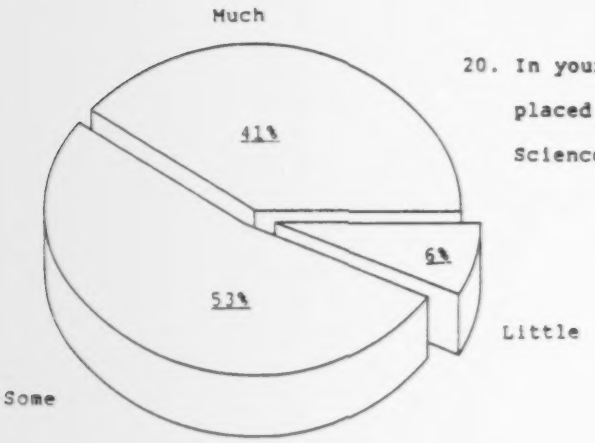
Science Content



Science Process and Skills:

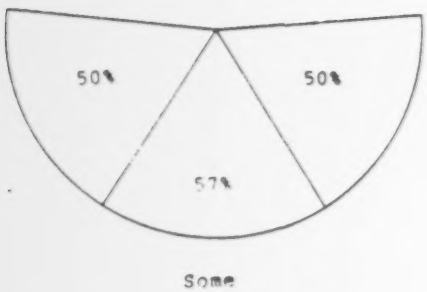
Much	33%	43%	50%	41%
Some	50%	57%	50%	53%
Little	17%	0	0	6%
Don't know	0	0	0	0

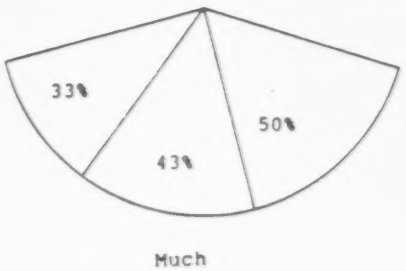
Mechling reported 62% "much", 33% "some", 5% "little", and no responses for the last item. Washington institutions reported far less favorably in this category, with nearly 59% of institutions ranking themselves as emphasizing process and methods "some" or "little" compared to 38% in the Mechling study. Although all institutions in Washington ranked lower than Mechling's results, private nonchurch institutions ranked the highest in this category for the state.



20. In your program, how much emphasis is currently placed on the following science education area?

Science Process and Skills

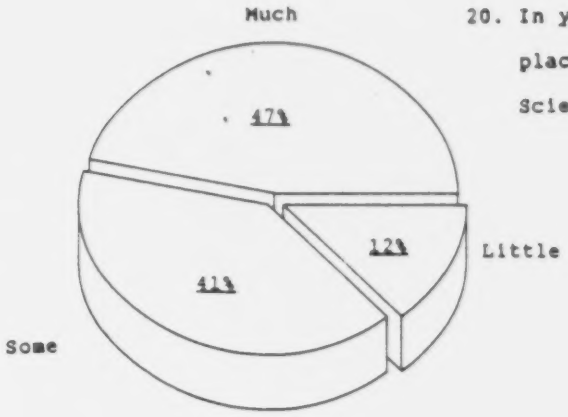




Science Teaching Techniques:

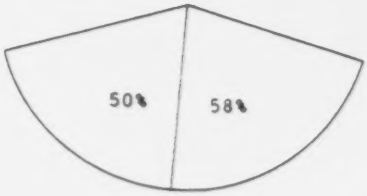
Much	33%	28%	100%	47%
Some	50%	58%	0	41%
Little	17%	14%	0	12%
Don't Know	0	0	0	0

Mechling reported 67% "much", 27% "some", 6% "little", and no responses in the last column. Fifty-three percent of Washington institutions ranked science teaching techniques as "some" or "little", contrasting to Mechling's 33%. Private nonchurch institutions ranked far superior to public or private church respondents.

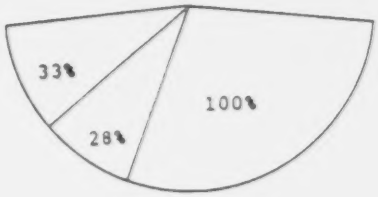


20. In your program, how much emphasis is currently placed on the following science education area?

Science Teaching Techniques



Some



Much

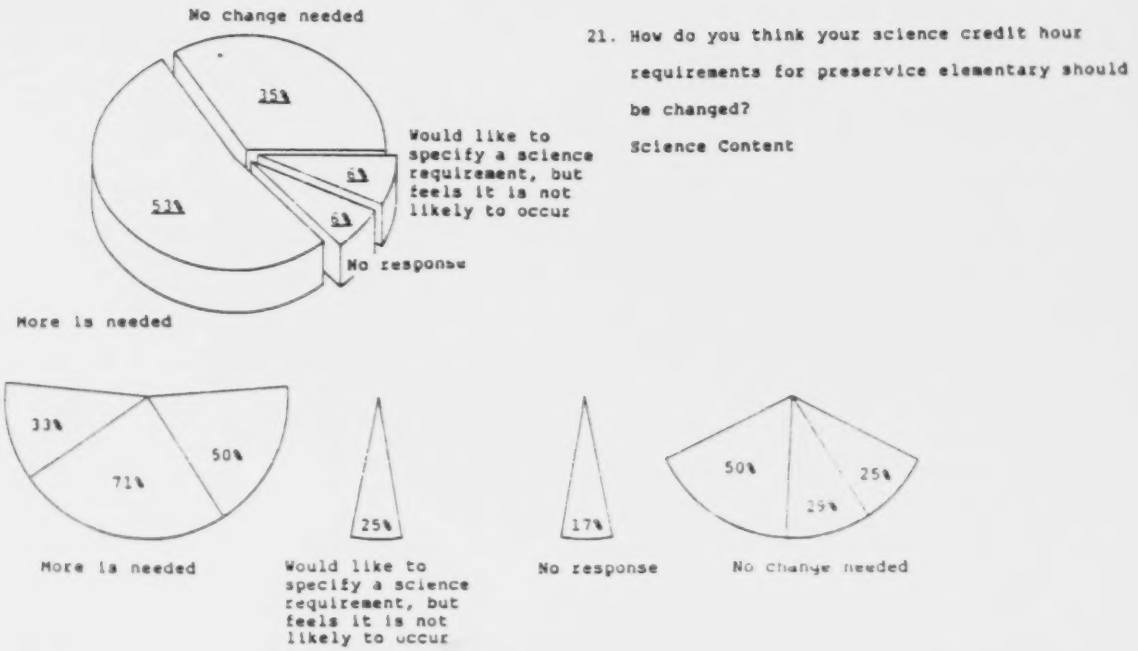
Little

21. How do you think your science credit hour requirements for preservice elementary should be changed?

The no response for this question was from Evergreen. When asked why they did not respond, they stated "we operate so differently it is difficult to answer in these terms."

	Public	Private Church	Private Nonchurch	Total
Science Content:				
No change needed	50%	29%	25%	35%
More is needed	33%	71%	50%	53%
Less is needed	0	0	0	0
Would like to specify a science requirement, but feels it is not likely to occur	0	0	25%	6%
No response	17%	0	0	6%

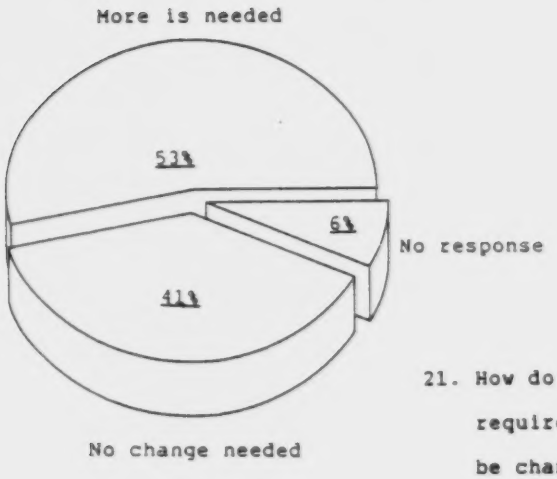
Mechling reported 42% no change, 58% more needed, and no responses for less. Private institutions generally agreed with Mechling's results, where public institutions preferred to remain at status quo.



Science Process and Skills:

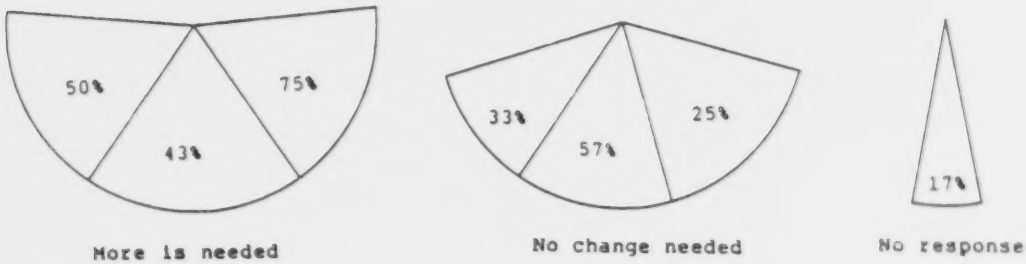
No change needed	33%	57%	25%	41%
More is needed	50%	43%	75%	53%
Less is needed	0	0	0	0
No response	17%	0	0	6%

Mechling reported 52% "no change needed", 48% "more is needed", and there were no responses for less. The statewide trend matched Mechling's, however private institutions ranked themselves to the extreme either for no change (church) or for more needed (nonchurch).



21. How do you think your science credit hour requirements for preservice elementary should be changed?

Science Process and Skills



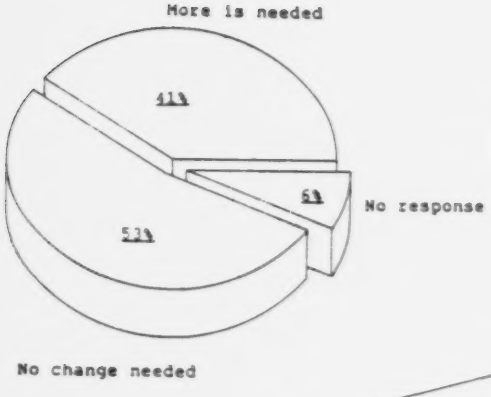
Science Teaching Techniques:

No change needed	50%	57%	50%	53%
More is needed	33%	43%	50%	41%
Less is needed	0	0	0	0
No response	17%	0	0	6%

One private nonchurch institution believes all three should be integrated. Two public institutions responded that they personally wanted more, but they realized that it would not be feasible to expect their departments to support this at this time. The public institutions also would like the requirements to reflect a greater diversity of areas than what are presently offered.

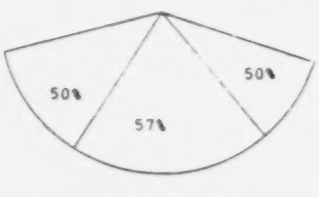
Mechling reported 50% no change, and 50% more needed, with no responses for less needed.

Among the respondents, the data shows a clearly perceived need for more credit hour requirements in all science areas: content, process and methods, and teaching techniques. Generally, public institutions feel less supportive for more credit hour requirements. It should be noted that public institutions also ranked themselves lower than either private institutions on the previous question.



21. How do you think your science credit hour requirements for preservice elementary should be changed?

Science Teaching Techniques



22. Is the science methods course taught by the Education faculty or by the Science faculty?

	Public	Private Church	Private Nonchurch	Total
Education faculty	50%	42%	75%	47%
Science faculty	33%	16%	25%	30%
Faculty with joint appointments	17%	42%	0	23%

In private church institutions 60% of science methods courses were taught by science faculty. Public institutions were split 50-50, and private nonchurch institutions courses were primarily instructed by the education faculty.

23. All things considered, how could elementary teacher candidates be better prepared by your institution to teach science? (Check all that apply)

	Public	Private Church	Private Nonchurch	Total
Provide more science content	15%	18%	0	15%
Provide more courses in methods of teaching science	7%	11%	14%	10%
Require laboratory courses in biological science, physical science, and earth science	7%	14%	14%	11%
Have courses specifically designed for elementary teachers	15%	18%	14%	16%
Require students to spend more time in school preparing to teach	15%	7%	0	10%
Achieve a better integration of science content, processes, and teaching methods	23%	18%	58%	24%
Require science teaching during student teaching	11%	7%	0	8%
Other	7%	7%	0	6%

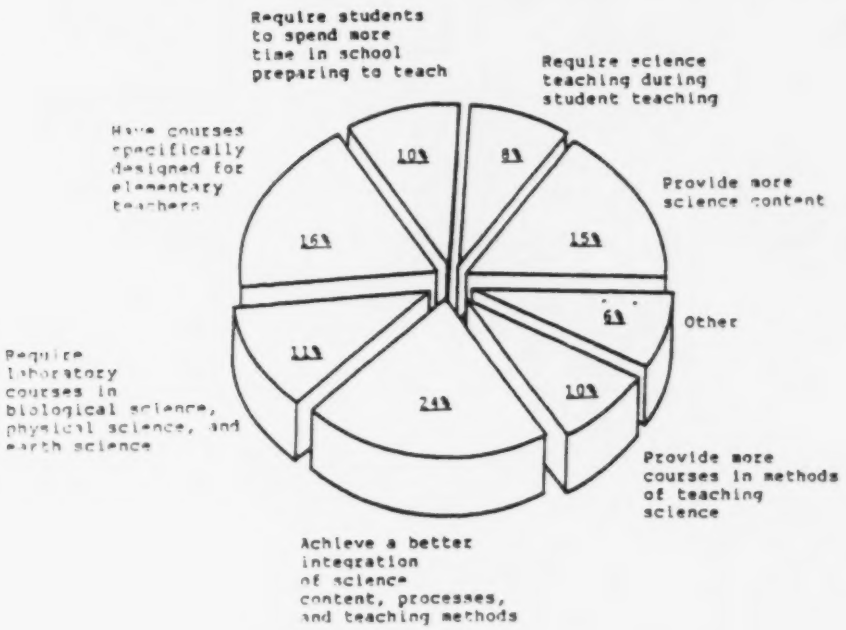
Two public institutions commented that they would like students to have a better opportunity for teaching science in practicums and have more cooperation with schools to encourage more science teaching in schools. A private church institution responded it would be ideal to have all of the above. Another private church institution remarked they would like to have good role models of science teaching in the field.

Evergreen responded that they would like to select more faculty who have a science background to teach full time for two years within their program.

Mechling reported a 20% response rate for more science content courses, compared to 15% in Washington. Less than 10% of Washington institutions support more methods of teaching science, while Mechling reported 17%. Specific laboratory courses for elementary teachers ranked 11% in Washington, compared to 13% by Mechling. Percentages nearly matched when considering requiring more time in school for the Mechling and Washington institutions. While Mechling reported only 10% suggested a better integration of content, process, and teaching methods, 24% of Washington institutions supported this item. Requiring science teaching during student teaching ranked 8% in Washington institutions, and 6% in Mechling's study.

It should be noted that since each institution carries a 6% weight, the results are very similar, with the exception of the item on better integration of science content, process, and teaching methods.

23. All things considered, how could elementary teacher candidates be better prepared by your institution to teach science? (Check all that apply)


Require students to spend more time in school preparing to teach
10%
Require science teaching during student teaching
8%
Have courses specifically designed for elementary teachers
16%
Provide more science content
15%
6%
Other
11%
Require laboratory courses in biological science, physical science, and earth science
24%
10%
Provide more courses in methods of teaching science
Achieve a better integration of science content, processes, and teaching methods

Require science teaching during student teaching

Other

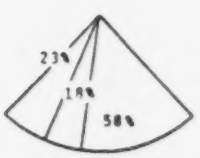
Provide more science content

Require laboratory courses in biological science, physical science, and earth science

Provide more courses in methods of teaching science

Have courses specifically designed for elementary teachers

Require students to spend more time in school preparing to teach



Achieve a better integration of science content, processes, and teaching methods

24. Please indicate the qualifications of the individuals who taught elementary science method courses at your institution during the 1988-89 school year.

Evergreen did not respond to this question.

	Public	Private Church	Private Nonchurch	Total
Fulltime Faculty:	6	4	4	14
Science degree	29%	33%	50%	37%
Science Education degree	57%	34%	33%	42%
Elementary Education degree	14%	0	0	5%
Curriculum degree	0	33%	17%	16%

The majority of the instructors statewide have a Science Education degree. Nearly 79% of the institutions have instructors with a science or science education degree.

Part-time Faculty:	1	3	4	8
Science degree	0	33%	50%	33%
Science Education degree	0	34%	17%	28%
Elementary Education degree	100%	33%	17%	25%
Curriculum degree	0	0	16%	14%

One private church institution reported that their instructor has an Elementary Education degree, however the individual was also a former science coordinator in public schools and has now retired from the K-12 system.

Of the part-time instructors in the institutions, sixty percent of the instructors have a science or science education degree.

Graduate Assistant/Teaching Assistant:	1	0	0	1
Science degree	0	0	0	0
Science Education degree	100%	0	0	100%
Elementary Education degree	0	0	0	0
Curriculum degree	0	0	0	0

Only one institution in the state used a graduate assistant as an instructor.

25. Is your institution currently redesigning its undergraduate elementary education program?

	Public	Private Church	Private Nonchurch	Total
Yes	34%	86%	50%	59%
No	66%	14%	50%	41%

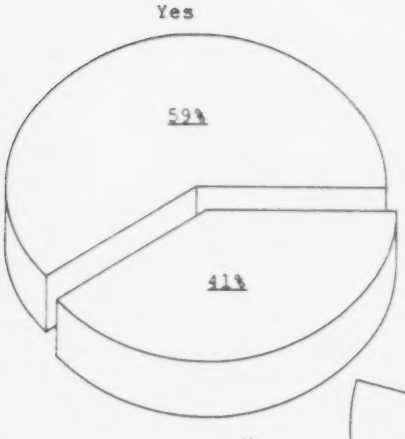
Three institutions responded they were shifting to the Master In Teaching (MIT) model (Evergreen, University of Puget Sound, and Seattle University) and could not state exact changes at this time.

Private church institutions responses included: re-doing science content and methods, changes are in the process and are not finalized; beginning work on establishing a sequence of content courses aimed at K-8 candidates which will be based on an integrated MIT program; methods of teaching science and health have been incorporated into one course which allows more contact time; the math and science methods component is now 5 quarter hours (it was a 2 quarter hour science and a 4 quarter hour math as two separate courses); and

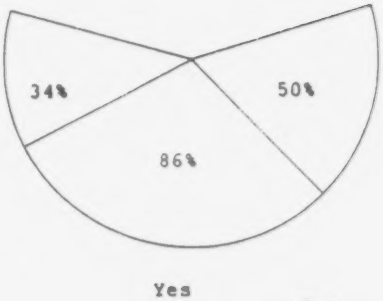
finally, yes we are redesigning, but there is little change in the science area.

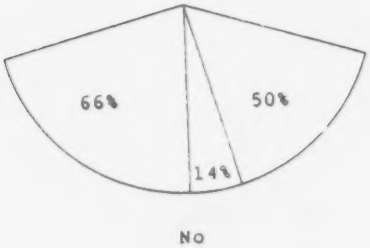
Private nonchurch institutions responded that the move to a MIT program allowed future teachers to enter the teacher training program with a previously earned degree in a content field, therefore, the institution didn't think it would change (either bad or good) the quality of preparation of elementary preservice teachers.

Dr. Zehm at Heritage had several comments. "We need to provide the following to improve science teaching and learning here and at other institutions of higher education: 1. interventions to reduce science anxiety for women and other "non-science" persons, 2. improvements in the way science is taught, 3. more quality and not just more quantity!, 4. improve methods of assessing knowledge, skills, and attitudes in science, and 5. more involvement with the "scientific method."



25. Is your institution currently redesigning its undergraduate elementary education program?





CHAPTER V

MAJOR RESULTS

The investigator of this study determined baseline data for the state of Washington in elementary preservice preparation in science. Items that were similar were compared to the Mechling baseline study of 1982. The NSTA statement based on the Mechling findings indicated that there is universal agreement that elementary teachers should have reasonable knowledge of science content. Overall, the majority of Washington institutions do not compare favorably with the NSTA standards.

The first standard reads that all institutions should require a minimum of 12 semester (18 quarter hours) of laboratory or field oriented science including courses in EACH of these areas: biological, physical, and earth science. Only Western Washington University, the University of Washington, and Heritage College met the NSTA guidelines for science hours. Western Washington University and Heritage College were the only institutions that met the subject area standards as well. Puget Sound did meet the subject area requirements, but not the number of hours required to satisfy the NSTA standards. The majority of

institutions prepare elementary teachers, who are expected to teach science, with the same background as any other university graduate.

Mechling reported 18% of the institutions required courses in all three areas. Mechling did not include an hour requirement in his survey.

The statewide average is 9.6 quarter hours of science. Public institutions average 13.7 quarter hours, private church institutions average 6.7 quarter hours, and private nonchurch institutions average 8.8 quarter hours. Mechling reported 8 semester hours (12 quarter hours) as the average.

Statewide, one-third of the institutions reported no change in science preparation programs, 21% reported increased course offerings, and 15% reported increased science budgets.

Eighty-eight percent of Washington institutions did not require additional science courses beyond general university requirements. Mechling reported 98% did not require additional science courses.

Forty-seven percent of Washington institutions reported the science courses that the preservice teachers took were required for professional education programs. Mechling reported that science courses were

required for professional education (5%), general university requirements (41%), and for both (54%).

Washington institutions reported 18% required no lab science. Mechling reported 16% required no lab.

Sixty-five percent of the institutions reported currently there is some emphasis placed on science content, with 23% reporting much emphasis. Mechling reported 49% some emphasis, 31% much, and 20% little.

Institutions reported 53% would like to have more science content in their programs, while 35% said no change was needed. Mechling reported 58% responded more is needed and 41% no change.

The second guideline concerned science process skills and developing a positive attitude through teaching techniques. Mechling reported 59% of the institutions did not have courses designed for elementary teachers, in Washington 71% reported they had not designed courses to meet the needs of elementary teachers. Private nonchurch institutions addressed this need the most.

The third NSTA recommendation concerned science methods courses, process skills, and teaching technique. The recommendation states preservice elementary teachers should be required to complete a

minimum of one SEPARATE course of 3 semester hours (4.5 quarter hours) in elementary science methods. All institutions except one had a separate science methods course. The science methods classes ranged from 3-4 quarter hours. Eighty-two percent of Washington institutions reported laboratory experiences and hands-on activities were included in the methods course. Mechling reported 73% of the courses included activities. Washington institutions reported science methods courses were taught by the Education faculty 47% of the time, Science faculty 30%, and by joint faculty 23%.

This recommendation also stated the course should develop instructional skills to teach science processes, attitudes, and content to elementary students. Ninety-four percent responded that process skills were taught. Mechling reported 85% did teach process skills. Forty-one percent of the institutions reported they felt they placed much emphasis on process skills. This is contrasted to the 62% that ranked their process skills as "much" in Mechling's study. Fifty-three percent of the institutions in Washington felt they needed more science process and skills in their preservice programs. The science methods course

was to include hands-on activities to promote skill development, positive attitudes, and instructional strategies. Mechling reported 48% felt more was needed.

Mechling reported 67% of institutions placed much emphasis on science teaching techniques. Washington institutions reported 47% much emphasis. Mechling reported 50% felt more was needed in this area. Washington institutions reported 41% felt more was needed. Each institution in Washington has a weight of 6%. If one institution would change their response, it could virtually nullified the differences between the Mechling study and these results concerning perceived needs.

The fourth area stated that preservice elementary teachers should have field experiences with children throughout the undergraduate program and this experience should include teaching science. Eight percent of the institutions responded that they would like to include this as a part of their student teaching program. Mechling reported 6% supported this guideline.

Recommendation five related to faculty preparation. NSTA guidelines stated that faculty

teaching science courses should have science credentials. Seventy-nine percent of the fulltime faculty, sixty-one percent of the part-time faculty, and all of the graduate assistants have a science background. City University did not have a fulltime faculty member with a science degree. Whitworth reported one part-time faculty that did not have a science degree, but the faculty was a science coordinator for a school district for several years. Washington State University reported that all faculty teaching science courses did not have science degrees. This researcher did attempt on three different occasions to reach this institution to verify their response. No contact was returned, so this researcher was unable to resolve the question. Evergreen State College did not respond to this question. The portion of the guideline concerning continuous involvement with elementary schools was not addressed in this research.

Recommendation six suggests that science courses be taught in a laboratory setting. Eighty-two percent of the institutions responded that they currently teach in a laboratory setting. Evergreen State College did not respond to the question. Washington State University and City University responded negatively. Mechling

repcrted 73% required lab experiences.

The final recommendation defined conditions relative to professional development. This question was not surveyed in this study.

Institutions rated their programs overall as 47% good, 41% adequate, and 12% poor. More emphasis is placed on science process, methods, and teaching technique than on science content. Institutions felt the greatest need to improve their programs were: a. achieve a better integration of science content, processes, and teaching techniques, b. have science courses specifically designed for elementary teachers, and c. provide more science content.

State certification and tradition were cited most often as the factors which had the most influence in determining science requirements for elementary teacher preparation. Currently, 59% of Washington institutions are redesigning their teacher education programs.

LIMITATIONS

There are several limitations usually associated with mailed surveys. It is recommended the return rate be greater than 80%. The 100% return rate in this study exceeded the minimum rate.

IMPLICATIONS

Without a science methods course, future teachers probably adopt the dominant teaching strategy of their college science professors - lecture. Teaching science in the elementary classroom is different than in a college situation. The elementary level teacher should translate the content/process of science into concepts/activities that elementary students may discover for themselves. The National Science Board (1983) recommended that preservice preparation should incorporate applications and interaction/application of science to society and technology courses.

Individuals desiring to teach at the elementary level cannot be prepared as specialists in all the subject matter areas which they are called upon to teach, at least within the present four year preparation period. Students preparing to teach elementary school frequently take one general course in teaching methodology. Due to time limitations, they do not receive training and experiences in sufficient depth in all of the subject matter areas. Elementary school teachers, because they lack familiarity with science content and materials, express reluctance to teach science (Blosser and Howe 1969).

RECOMMENDATIONS

Overall, institutions have not implemented the NSTA standards for elementary teacher preparation in science. Future teachers do not appear to be trained to deal with science, society, and technological concerns. The adequacy of these programs is a crucial component in determining whether future teachers are adequately preparing their students for the 21st century. Research needs to be done to determine how the preservice program for elementary school teachers can be structured to provide as wide a range of experiences and instructional content in science as possible. Baseline data from all the states are needed first in getting the attention of those who might move in that direction. More research needs to be done in science education at the elementary school level to show the relationship between preparatory programs and product outcomes. What might happen if teachers learned how their behavior impacted students? What if students, who already like science, were in classrooms where they saw their teachers as personally interested, enthusiastic, and as excited about science as they were?

Few research studies have been done that lead to development of any theory of instruction relative to science teaching at the elementary level. Would it differ if science were to be taught to elementary school children by a teacher specializing in science as opposed to the present classroom teacher who has been trained to function as a generalist?

Current certification patterns appear to be based on courses completed rather than upon classroom performance. Are the ideas of "legally qualified" and "competent" teachers equivalent ones? Some institutions meet the letter of the law by requiring one science class, and meet the state standards by designing a combination science/health or science/math methods class. No minimum hour requirements are given in the state guidelines. No science class beyond a general university requirement is mandated. More research should be conducted relevant to the problems of teacher competence.

Many new teaching strategies have been appearing in the elementary school - teacher empowerment, cooperative learning, and peer teaching. Research should be done to determine the degree to which prospective elementary teachers are being prepared to

make effective use of these strategies and how to implement them in science. Are prospective teachers being prepared to function in such a changing environment? A related concern is that research needs to explore the ways in which elementary teachers handle the problem of individualization of science instruction and the ways which they accommodate the individual differences of their students.

Areas for future study should include: content and experiences to be provided in the preparatory program, the relationship of the content and experiences to teacher behavior, and the relationship resulting between teacher interaction and student behavior in the classroom situation. If the investigation is designed and carried out in such a way that the data can be tabulated, analyzed, and interpreted so that the study can be replicated, then the findings can be generalized and applied to a wide area.

There are other topics for investigation. Are there correlations between preservice teachers' perceived inadequacies in teaching science and their ideas of the purpose of teaching science in the elementary school? Is there a correlation between the number of high school science courses taken and the

number of college science courses taken by preservice teachers? Are there differences in the perceived purposes and concerns of teaching science between preservice and inservice teachers? How do the anxieties of preservice elementary teachers toward science influence science teaching. Once the concerns are identified, it may be possible to alleviate many of them through courses.

Increased practice with actual science teaching, both to peers and to elementary students, may reduce some of the fears. Wiser selection of science content could be considered. Courses should be more practical and less theoretical with more appropriate experiments. Increased numbers of students and faculty could attend and participate in science conferences that would benefit both instructors and allow preservice teachers exposure to educational organizations and support systems. More faculty and students could serve as judges at science fairs and summer science camps, which would allow more positive exposure to science related activities.

Perhaps the departments of biology, geography, chemistry, health sciences, geology, and physics, in collaboration with the department of elementary

education, could design courses that are tailored to provide content and skills which are basic in scientific literacy and which are applicable to the elementary science curriculum. This does not imply that they are watered down versions of more difficult courses. In addition, let these classes be taught by faculty who have subject matter expertise, a background in science methods, well-honed teaching skills, enthusiasm for working with preservice teachers, and who wish to continue having contact with elementary schools. These science instructors should remain current in science by continuing to teach in the science department as well.

Methods instructors should be models of effective science teaching strategies. This should include the creation of a classroom environment (yes, posters on the walls) that promote positive attitudes toward science, including small group investigation, questioning, discussion, use of instructional media, role playing, recording data, building models, and brainstorming. Preservice teachers should be involved in an activity from a student's point of view, and then discuss it from a teacher's point of view.

A major theme of the methods class could be to identify major sources of information about science teaching and learn how to use them, even though we cannot learn every interesting way to approach every concept or skill. Science lab situations are also a place for students to recognize differences in Piagetian levels of functioning as they work with children of different abilities and backgrounds in the school setting. Perhaps grouping and regrouping students for science teaching, as is done for reading, based on Piaget, would also help foster positive experiences in science for both the preservice teacher and their students.

If opportunities were available for inservice and preservice teachers to share experiences together, perhaps through discussions, both would benefit. Several possibilities come to mind. A summer science camp might gather children, teachers in training, and university faculty to promote science. A science seminar series could bring scientists and science educators to a campus for a one or two week period of intensive work with preservice teachers, inservice teachers, and faculty. A science education center could provide statewide leadership and resources for

science education. A learning/teaching support team of preservice teachers and faculty might develop the science knowledge, attitudes, processes, and skills for inservice teachers who needed more science background.

> "The root of the present crisis, and the fertile seedbed of a brighter future in science education, is the elementary teacher preparation program. If teachers can be taught to present science in ways that reflect what we now know about the nature of science and the way children learn science, tomorrow will be brighter for their students and their student's children (Penick 1978)."

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APPENDICES

GUIDELINES ADOPTED BY THE NSTA

The following standards were adopted and approved by the NSTA Board of Directors in 1983 at the Dallas, Texas Convention:

1. A minimum of 12 semester hours of laboratory or field oriented science to include courses in the areas of biological, earth, and physical science should be required.

2. Courses should be adapted to the elementary education major by applying knowledge relevant to the elementary school classroom, increasing the use of science processes, and by encouragement of a more positive attitude toward science instruction at the elementary school level.

3. A separate science methods course should be required of all graduates, with a minimum of three semester hours of credit. This course should promote process skills development, the ability to select appropriate science content for elementary students, the design of classroom environments which encourage a positive attitude toward science, the selection and use of a variety of instructional strategies, as the development of diverse evaluation strategies.

4. Field experiences should include science instruction.

5. The faculty member who teaches sciences content courses should have science credentials. Methods instructors should have specific training and experience in teaching elementary school science and have continuous involvement with elementary schools.

6. Preservice science instruction should occur in a science laboratory setting.

7. Teachers should have a professional orientation toward science and science instruction.

FIELD TEST INSTITUTIONS

	Responded
Dr. Al McGlinsky Chair, Dept. of Education College of Idaho Caldwell, Idaho 83605	Yes
Dr. Frossard Idaho State University P.O. Box 8054 Pocatello, Idaho 83209 1 208 236 3370	Yes
Lewis-Clark State College Lewiston, Idaho 83501	Yes
Dr. Dennis Cartwright Northwest Nazarene College 623 Holly Street Nampa, Idaho 83651	Yes
Dr. Dale Gentry University of Idaho Moscow, Idaho 83843 1 208 885 6772	Yes

Science Education 90

COVER LETTER FOR IDAHO FIELD TEST

January 15, 1990

Dr. Dale Gentry
Dean of Education
University of Idaho
Moscow, Idaho 83843

Dear Dr. Gentry,

I am requesting your response to this field test. The purpose of my study is to investigate the science requirements within the elementary teacher preparation programs in the state of Washington. I need to have data from each institution for my study, so I prefer not to use any institutions from Washington in my field test.

I have enclosed a copy of the cover letter, questionnaire, and follow up letter. I request that you actually complete the questionnaire, so that I can do a trial run of computer data analysis. If you have any comments to make concerning the letters or the instrument itself, please include them when you return the study. I have enclosed a stamped, self-addressed envelope for your convenience. The final survey instrument will be printed January 30, 1990. Please return the instrument by that date.

If you have additional descriptive information about science requirements which you believe I should include in the instrument, I would appreciate receiving it. If you wish to discuss any aspect of the questionnaire or if you need clarification, please feel free to call me at my office, (509) 359 2236, or at home, (509) 235 5471.

Thank you for your cooperation. I am looking forward to hearing from you.

Sincerely,

Sandy Melchert

INSTITUTIONS SURVEYED

Public Institutions	Responded YES	NO
Central Washington University Dr. Ronald Frye Director of Certification and Assistant Dean School of Professional Studies Black Hall Room 216 Ellensburg, WA 98926 509 963 1411 SCAN 453 plus last 4 digits	*	
Eastern Washington University Dr. William Shreeve Chairman, Department of Education Cheney, Wa 99004 509 359 2232	*	
Evergreen State College Dr. John Parker Director, Cooperative Education Olympia, WA 98505 206 866 6000 SCAN 727 6000	*	
University of Washington Dr. Roger Olstad Acting Dean, Education Seattle, WA 98195 206 543 2100 SCAN 323 2100	*	
Washington State University Dr. Robert Harder, Assoc. Dean Dept. of Education, Cleveland 160 Pullman, WA 99164 509 335 3564	*	
Western Washington University Dr. Larry Marrs Dean, School of Education Bellingham, WA 98225 206 676 3000 SCAN 532 3000	*	

Private, Church Affiliated Institutions	Science Education 92 Responded YES	NO
Gonzaga University Dr. Janet Brougher Dean, School of Education E. 502 Boone Ave. Spokane, WA 99258-0001 509 328 4220	*	
Pacific Lutheran University Dr. Robert Mulder Dean, School of Education Tacoma, WA 98447 206 535 7272	*	
Saint Martin's College Dr. Joyce Bryant Assistant Professor - Math/Science Old Main Lacey, WA 98503 206 491 4700	*	
Seattle Pacific University Dr. Raymond Myers Professor of Science Education Third W. and W. Bertona St. Seattle, WA 98119 206 281 2214	*	
Seattle University Dr. Margit McGuire Dean, School of Education Seattle, WA 98122 206 296 6000	*	
Walla Walla College Dr. Gail Rittenbach Department of Education 208 Smith Hall College Place, WA 99324 509 527 2615	*	
Whitworth College Dr. Dennis Sterner Chairman, Education Department Spokane, WA 99251 509 466 3229	*	

Private, Nonchurch Institutions	Responded YES	NO
City University Dr. Gordon Albright Associate Dean of Education 16661 Northup Way Bellevue, WA 98008 206 643 2000 1 800 542 9845	*	
Heritage College Dr. Stanley Zehm Department Chairman, Education Route 3, Box 3540 Toppenish, WA 98948 509 865 2244	*	
University of Puget Sound Dr. Robert Steiner School of Education 1500 N. Warner Tacoma, WA 98416 206 756 3375	*	
Whitman College Dr. David May Director, Teacher Education Walla Walla, WA 99362 509 527 5128	*	

Currently Not Certifying:
Private, Church Affiliated Institution

Antioch University Seattle Dr. Lois LaShell Director, MA Education Seattle, WA 98121 206 441 5352	*	

COVER LETTER

January 22, 1990

Dean of Education
School
Town, State, Zip

Dear Personalized Letter:

Reports indicate that science education in the United States is in serious trouble. At the elementary level, no baseline data has been collected in Washington State on teacher preparation in science. The purpose of this study is to investigate the science requirements within the elementary teacher preparation programs. The information I am requesting is very important to the information base in science education.

I have enclosed a questionnaire which is being sent to every institution in Washington which certifies elementary teachers. Because the number of institutions is small (19), your participation is crucial. Please take approximately 20 minutes to complete the enclosed questionnaire. If, after examining the questionnaire, you feel that there is someone else at your institution who may be able to respond more accurately, I would appreciate it if you would ask them to complete it. Please return the questionnaire in the stamped, self-addressed envelope provided for your convenience before February 15, 1990.

If you have additional descriptive information about your science requirements or preparation program for elementary teachers which you believe may be useful to me, I'd appreciate receiving it. If you would like to have a copy of the results of this survey, please indicate so on the questionnaire in the space provided. Also, if you wish to discuss any aspect of the questionnaire or if you need a clarification, please feel free to call me at my office, (509) 359 2236, or at home, (509) 235 5471.

Thank you for your cooperation. I am looking forward to hearing from you.

Sincerely,

Sandy Melchert

FOLLOW UP LETTER

February 16, 1990

Dean of Education
School
Town, State, Zip

Dear Personalized Letter:

During late January I sent you a questionnaire concerning preservice elementary science education. Although I have received an excellent return thus far, I have not yet received a response from your institution.

In order to adequately describe the teacher preparation programs in Washington State, I need a response from each institution that certifies elementary teachers. I have enclosed another copy of the explanatory cover letter and the questionnaire. I would appreciate it very much if you would pass this information along for completion by someone knowledgeable about preservice teacher preparation.

I need to receive your response by February 28, 1990, so that I can proceed with my analyses. A stamped, self-addressed envelope is provided for your convenience.

Thank you for your help.

Sincerely,

Sandy Melchert

INSTITUTIONS REQUESTING RESEARCH RESULTS

Dr. Al McGlinsky, College of Idaho
Dr. Dale Gentry, University of Idaho
Dr. Dennis Sterner, Whitworth College
Dr. Gail Rittenbach, Walla Walla College
Dr. Janet Brougher, Gonzaga University
Dr. John Parker, Evergreen State College
Dr. Joyce Bryant, St. Martin's College
Dr. Ken Mechling, Clarion University
Dr. Larry Marrs, Western Washington University
Dr. Lloyd Barrow, University of Missouri
Dr. Lois LaShell, Antioch University
Dr. Margit McGuire, Seattle University
Dr. Merle Greenway, Walla Walla College
Dr. Raymond Myers, Seattle Pacific University
Dr. Robert Frossard, Idaho State University
Dr. Robert Gibbs, Eastern Washington University
Dr. Robert Harder, Washington State University
Dr. Robert Mulder, Pacific Lutheran University
Dr. Robert Steiner, University of Puget Sound
Dr. Roger Olstad, University of Washington
Dr. Ron Frye, Central Washington University
Dr. Stanley Zehm, Heritage College

PRESERVICE ELEMENTARY SCIENCE EDUCATION QUESTIONNAIRE

Institution Name and Address:

_____

_____

_____

Please mail the questionnaire in the enclosed envelope to:

Sandy Melchert
Eastern Washington University
Education Department, Mailstop 90
Cheney, Washington 99004

If you would like a copy of the results of this research, please complete the following information.

Name _____

Title _____

Institution _____

Address _____

City _____ State _____ Zip _____

Part I: Introductory

1. Does your institution prepare preservice elementary teachers?

___ Yes ___ No

If yes, please continue with the survey.

If no, please place the survey in the enclosed envelope, and return it to me. Thank you.

Part II: Elementary Teacher Preparation

1. In which of the following categories are elementary education graduates from your institution certified to teach?

___ K-6 ___ K-8 Other: Specify _____

2. What is the number of elementary education majors that graduated from your institution in 1989? _____

3. What is your full-time enrollment during the 1989-90 academic year in the School of Education? _____

4. Which of the following describes your college or university?

___ Public institution
___ Private institution, church affiliated
___ Private institution, non-church affiliated

5. For elementary teacher candidates, how many total credit hours of science are required (excluding science methods courses)?_____

Are these semester or quarter hours? _____

6. During the past five years, which of the following best describes the yearly trend of undergraduate elementary education majors that have graduated from your institution?

___ Sharply decreased
___ Sharply decreased, then leveled off

___ Moderately decreased
___ Remained fairly steady
___ Moderately increased

___ Sharply increased, then leveled off
___ Sharply increased

7. Which of the following changes has the science component of your elementary education program undergone during the past five years?
(Check all that apply)

___ Fewer course offerings ___ Increased course offerings
___ Smaller class or section size ___ Larger class or section size

___ Decreased number of credits per course
___ Increased number of credits per course

___ Decreased science education budgets relative to other components of teacher education
___ Increased science education budgets relative to other components of teacher education

Other: Please specify

8. Do your preservice elementary teachers take a science teaching methods course designed to assist them to learn how to teach science or is science included in a general methods of instruction course?

___ Science methods course ___ General methods course ___ Both

9. Are elementary teacher candidates required to elect additional science courses beyond general university requirement's?

___ Yes ___ No

Is a science methods course an option? ___ Yes ___ No

10. Are elementary teacher candidates required to take science courses as a part of their general university requirements, their professional education requirements, or both?

___ General university requirement ___ Professional education
___ Both

11. In which of the following <u>areas</u> are elementary teacher candidates <u>required</u> to take courses? (Check all that apply)

___ Physical sciences
___ Biological sciences
___ Earth sciences
___ General science
___ Physical Geography

Other: please describe _____

12. How many hours are required in each area for elementary teacher candidates?

___ Physical science
___ Biological science
___ Earth Science
___ General Science
___ Physical Geography
___ Other

13. How many of the science content courses required of elementary education majors must include laboratory work? (Check one)

___ None ___ One ___ Two ___ More than two

Other: please specify _____

14. If science courses are required, are they designed <u>specifically</u> to meet the needs of preservice elementary teachers?

___ Yes ___ No Other: please explain _____

15. Are preservice elementary teachers taught science process skills such as observation, measurement, prediction, analysis of data, control of variables, and design of investigations, etc?

___ Yes ___ No

16. Where are these process skills taught?

___ Science courses ___ Methods courses ___ Both

17. Do the science method courses taken by the elementary teacher candidates include laboratory experiences and hands-on activities in addition to lecture?

___ Yes ___ No

18. In your estimation, what factors have had the most influence in determining the science and/or science teaching methods course requirements for elementary teacher candidates at your institution? (Check all that apply)

___ Tradition
___ Accreditation agencies such as NCATE
___ State certification guidelines
___ Professional Science Association guidelines

Other: please describe _____

19. As you consider your total program for preparing preservice elementary teachers for teaching science, how would you rate its overall effectiveness?

___ Excellent ___ Good ___ Adequate ___ Poor ___ Don't know

20. In your program, how much emphasis is currently placed on the following science education areas?

Science Content: ___ Much ___ Some ___ Little ___ Don't Know

Science Process and Skills: (Methods) ___ Much ___ Some ___ Little ___ Don't know

Science Teaching Techniques: ___ Much ___ Some ___ Little ___ Don't Know

21. How do you think your science credit hour requirements for preservice elementary should be changed?

Science Content: ___ No change needed
___ More is needed
___ Less is needed

Science Process and Skills: (Methods) ___ No change needed
___ More is needed
___ Less is needed

Science Teaching Techniques: ___ No change needed
___ More is needed
___ Less is needed

22. Is the science methods course taught by the Education faculty or by the Science faculty?

___ Education faculty ___ Science faculty

___ Faculty with joint appointments

23. All things considered, how could elementary teacher candidates be better prepared by your institution to teach science?
(Check all that apply)

___ Provide more science content
___ Provide more courses in methods of teaching science

___ Require laboratory courses in biological science, physical science, and earth science
___ Have courses specifically designed for elementary teachers
___ Require students to spend more time in school

___ Achieve a better integration of science content, processes, and teaching methods
___ Require science teaching during student teaching

___ Other: Please specify _____

24. Please indicate the qualifications of the individuals who taught elementary science method courses at your institution during the 1988-89 school year.

___ Full-time Faculty:
- ___ Science degree
- ___ Science Education degree
- ___ Elementary Education degree
- ___ Curriculum degree
- ___ Other _____

___ Part-time Faculty:
- ___ Science degree
- ___ Science Education degree
- ___ Elementary Education degree
- ___ Curriculum degree
- ___ Other _____

___ Graduate Assistant/ Teaching Assistant:
- ___ Science degree
- ___ Science Education degree
- ___ Elementary Education degree
- ___ Curriculum degree
- ___ Other _____

25. Is your institution currently redesigning its undergraduate elementary education program?

___ Yes ___ No

If yes, summarize the modifications that will influence science education preparation for elementary preservice teachers.

_____

_____

_____

_____

Comments:

_____

_____

_____

_____

_____

Please accept my sincere thanks for your cooperation.